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# THE PARTICIPATION OF PROTEIN PRECURSORS IN THE MECHANISM OF THE SYNTHESIS OF SPECIFIC PROTEINS[1]

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ABSTRACT

Experiments were conducted on intact and isolated lactating mammary glands of goats. Amino acids and blood plasma proteins were washed off isolated mammary glands. It was found that isolated glands maintained their capacity to synthesize lactic proteins under these conditions. It was concluded that these proteins emanated from amino acids present in tissue proteins of the mammary gland.

Currently, the hypothesis that the synthesis of specific cellular /942* proteins occurs in ribosomes (polysomes) of amino acids bound with the transport form of RNA is widely accepted. Here, information RNA plays the role of a matrix during the formation of a polypeptide chain. In addition, it is well known that a number of physico-chemical and biological qualities of proteins can be sharply altered due to a change in the tertiary and quaternary structure of protein.

It is also known that for the synthesis of cellular and tissue proteins, amino acids present in blood plasma circulating through organs, other amino acids, and possibly even heavy peptide groups released during the breakdown of tissue proteins are used. This phenomenon was the subject of Ivanov et al. (ref. 1) and Meyerson (ref. 2) using developing or regenerating muscle tissue.

However, it should be noted that in these studies (refs. 1, 2) the presence of protein precursors was proposed on the basis of a number of circumstantial data, in particular, features of the dynamics of tagged amino acids (ref. 1) introduced into various muscle protein fractions.

The present experiment was designed to demonstrate through a direct approach the presence of protein precursors in tissues (the lactating mammary

*Numbers given in margin indicate pagination in original foreign text.

[1](Submitted by Academician A. I. Oparin, 9 Aug. 1965)

gland). It is known that lactic proteins are synthesized in the mammary gland from unbound amino acids and possibly are partially formed from blood plasma proteins (refs. 3-6). However, the problem of the role of proteins of this gland in the synthesis of lactic proteins recently has not received attention. To solve this problem, it seemed necessary to us to investigate the function of lactating gland (milk production) when isolated and perfused in an erythrocyte suspension washed clean of amino acids and blood plasma proteins. The ability of a gland to produce milk under these conditions would be direct evidence of the validity of our hypothesis concerning the possible synthesis of specific proteins from amino acids present in tissue and organ proteins.

Experiments were conducted on the isolated lactic glands of goats perfused in a triple-washed 0.85 NaCl suspension of erythrocytes combined with equal amounts of Ringer's solution and polyglucin with added glucose. The perfusion was maintained at 38° for 2 to 2-½ hr and was constantly oxygenated by an artificial blood circulation device. The gland was carefully milked prior to the beginning of a test after a preliminary injection of oxytocin. After removal of the gland and prior to its placement in the artificial blood circulation device, milking was again conducted twice to assure complete elimination of residual milk.

The amount of casein and serum proteins and amino nitrogen in the perfusate was determined from milk obtained from both in-situ and in-vitro sources. The amount of amino nitrogen in the perfusate plasma was close to zero /943 prior to perfusion. After perfusion, the amount sharply increased.

As evident from Table 1, the isolated lactating mammary gland maintains its capacity to synthesize lactic protein when perfused by an erythrocyte suspension washed of blood amino acids and proteins. Here, the quantity of

TABLE 1. CONTENT OF PROTEIN FRACTIONS IN MILK (AVERAGED FROM 5 TESTS)

| | General protein | Casein | Serum Proteins |
|---|---|---|---|
| Before erythrocyte perfusion (percent of milk) | 2.85 | 2.41 | 0.44 |
| After erythrocyte perfusion during the course of 2 hr | | | |
| In mg: | 1625 | 1273 | 352 |
| percent of milk | 4.66 | 3.64 | 1.02 |
| percent of control[1] | 42.2 | 39.6 | 57.4 |

[1]Control consisted of the same indices in the milk of a live goat (in-situ milk) for 2 hr.

synthesizable proteins (2 hr), despite a decrease when compared to their formation in situ (40 percent of the normal amount), nonetheless remained at a sufficiently high level. This situation applied both to the general protein content of milk and the content of some individual fractions.

Thus, there is no doubt that lactic proteins can be actively synthesized from amino acids present in mammary gland tissue proteins.

From Table 1 and from data obtained from an electrophoretic investigation of lactic proteins (these data will be published separately), it is evident that the fractional composition of lactic proteins, obtainable during perfusion of an isolated gland by a liquid free of unbound amino acids, differs from the makeup of normal milk in our tests. Milk taken from an isolated gland was usually characterized by a higher concentration of casein and serum proteins. The relationship between individual fractions of milk serum proteins produced in an isolated mammary gland also deviated from normal. This doubtless means that under our experimental conditions, milk was actively formed in the mammary gland during its re-perfusion. The only possible source of amino acids during this period could have been proteins present in the mammary tissue itself. These proteins might therefore be considered as original, more or less specific, precursors of lactic proteins. It is entirely possible that this mechanism has a more far reaching biological significance.

We are continuing experiments along these lines.

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